



# AASHTO Guidelines for Traffic Data Programs

AMERICAN ASSOCIATION OF  
STATE HIGHWAY AND  
TRANSPORTATION OFFICIALS

**AASHTO**  
THE VOICE OF TRANSPORTATION

Currently in preview, click buy full versi

Copyright © 2009, by the American Association of State Highway and Transportation Officials. All Rights Reserved. Printed in the United States of America. This book, or parts thereof, may not be reproduced in any form without written permission of the publishers.

# Acknowledgments

This work was sponsored by the American Association of State Highway and Transportation Officials, in cooperation with the Federal Highway Administration, and was conducted in the National Cooperative Highway Research Program.

Thanks to the authors Anita Vandervalk-Ostrander, Cambridge Systematics, Inc., Tallahassee, Florida; Shawn Turner, Texas Transportation Institute, College Station, Texas; Mark Hallenbeck, Washington State Transportation Center, Seattle, Washington; Joe Wilkinson, Chaparral Systems Corporation, Santa Fe, New Mexico.

## Disclaimer

Any opinions and conclusions expressed or implied in the report are those of the research agency. They are not necessarily those of the Transportation Research Board, the National Academies, or the program sponsors.

Currently in preview, click buy full version

# Executive Committee

2008–2009

## Voting Members

### Officers:

*President:* Allen Biehler, Pennsylvania

*Vice President:* Larry L. “Butch” Brown, Sr., Mississippi

*Secretary-Treasurer:* Carlos Braceras, Utah

### Regional Representatives:

REGION I: Carolann Wicks, Delaware, *One-Year Term*  
Joseph Marie, Connecticut, *Two-Year Term*

REGION II: Larry L. “Butch” Brown, Mississippi, *One-Year Term*  
Dan Flowers, Arkansas, *Two-Year Term*

REGION III: Kirk T. Steudle, Michigan, *One-Year Term*  
Nancy J. Richardson, Iowa, *Two-Year Term*

REGION IV: Rhonda G. Faught, New Mexico, *One-Year Term*  
Will Kempson, California, *Two-Year Term*

## Nonvoting Members

*Immediate Past President:* Pete K. Rahn, Missouri

*AASHTO Executive Director:* John Horsley, Washington, DC

# Standing Committee on Planning

## 2008–2009

*Chair*, Debra L. Miller, Kansas, (785) 296-3461  
*Vice Chair*, Susan P. Mortel, Michigan, (517) 373-0343  
*Secretary*, Ronald D. McCready, AASHTO, (202) 624-5807

---

### State Member

#### Alabama

Don T. Arkle, P.E.  
Robert J. Jilla, P.E.

#### Alaska

Ron King  
Jeffery Ottesen

#### Arizona

Rakesh Tripathi

#### Arkansas

Scott E. Bennett  
Alan Meadors

#### California

Joan Sollenberger

#### Colorado

Jennifer Finch

#### Connecticut

Charles S. Barone  
H. James Boice  
Gerald T. Jennings

#### Delaware

Ralph Reeb

#### District of Columbia

Karina Ricks

#### Florida

W. David Lee  
Kathleen Neill

#### Georgia

Angela T. Alexander  
Harvey D. Keetler  
Michael L. Thomas, P.E.

#### Hawaii

Ken Takaguchi,

#### Idaho

Matthew E. Moore, P.E.

#### Illinois

Dick Smith

#### Indiana

Vacant

#### Iowa

Stuart P. Anderson, P.E.  
Neil Volmer

#### Kansas

Chris J. Herrick, P.E.  
Dennis R. Slimmer

#### Kentucky

Mike Hancock

#### Louisiana

Eric I. Kalivoda  
Michael G. Schiro

#### Maine

Dale F. Doughty  
Raymond Faucher, P.E.

#### Maryland

Douglas H. Simmons

#### Massachusetts

Kenneth S. Miller, P.E.  
David Mohler

#### Michigan

Susan P. Mortel  
Tim Hoeffner

#### Minnesota

Timothy J. Henkel

#### Mississippi

Steven K. Edwards, P.E.,  
P.L.S.  
Jeffrey A. Pierce

#### Missouri

Machelle Watkins

#### Montana

Sandra S. Straehl

#### Nebraska

Randall D. Peters, P.E.

#### Nevada

Kent Cooper

#### New Hampshire

William E. Watson, Jr.

#### New Jersey

Brent Barnes  
Mark Stout

#### New Mexico

Muffet Foy Cuddy  
Patricia Oliver-Wright

#### New York

Lynn Weiskopf  
Robert Zerrillo

#### North Carolina

Deborah M. Barbour, P.E.  
Mike Bruff, P.E.  
Calvin W. Leggett, P.E.

#### North Dakota

Scott Zainhofski

#### Ohio

Jennifer Townley  
Howard P. Wood

#### Oklahoma

Jingyi McGovern, P.E.  
L. C. Streb, P.E.

#### Oregon

Jerri Bohard  
Rian Windsheimer

#### Pennsylvania

James D. Ritzman  
Thomas E. TenEyck

#### Puerto Rico

Gabriel A.  
Rodriguez-Fernandez

#### Rhode Island

Robert A. Shawver, P.E.

#### South Carolina

Ron Patton  
Mark Pleasant

#### South Dakota

Tim Bjorneberg  
Ben Orsbon  
Jerry Ortbahn

#### Tennessee

Jeanne Stevens, AICP

#### Texas

James L. Randall, P.E.

#### Utah

Ahmad Jaber, P.E.  
John H. Thomas, P.E.

#### Vermont

Melvin E. Dana

#### Virginia

Marsh C. Fiol

#### Washington

Brian J. Smith, AICP

#### West Virginia

Robert L. Pennington, P.E.

#### Wisconsin

Sandra K. Beaupre, AICP  
Mark J. Wolfgram

#### Wyoming

Martin Kidner, P.E.

### U.S. DOT Member

#### FHWA

James A. Cheatham, P.E.

#### FRA

Robert E. Martin, Jr.

#### FTA

Charles R. Goodman

### Associate Member—Federal

#### USDA Forest Service

Joel Krause

### Associate Member—International

#### Alberta

Brian Marcotte

#### Manitoba

Amar Chadha, P.E.

#### Northwest Territories

Russell Neudorf

#### Saskatchewan

George Stamatinos

# Highway Subcommittee on Traffic Engineering

## 2008–2009

*Chair, Delbert McOmie, Wyoming*  
*Vice Chair, Thomas Hicks, Maryland*  
*Secretary, Robert E. Arnold, FHWA*  
*Liaison, Ken Kobetsky, AASHTO*

### Alabama

Timothy C. Taylor, P.E.

### Alaska

Kurtis J. Smith, P.E.

### Arizona

Mike Manthey, P.E.  
 Richard C. Moeur, P.E.

### Arkansas

Eric Phillips  
 Tony Sullivan

### California

Robert Copp

### Colorado

Gabriela Vidal

### Connecticut

John F. Carey, P.E.

### Delaware

Mark Luszcz, P.E., PTOE  
 Donald D. Weber, P.E.

### District of Columbia

Soumya S. Dey  
 Yanlin Li

### Florida

Mark C. Wilson, P.E.

### Georgia

Keith Golden, P.E.

### Hawaii

Alvin Takeshita

### Idaho

Brenn Johnson, P.E.

### Illinois

Aaron Weatherholt

### Indiana

J. James Poturalski  
 Carl T. Tuttle

### Iowa

Timothy D. Crouch

### Kansas

David A. Church, P.E.  
 Kenneth F. Hurst, P.E.

### Kentucky

Vacant

### Louisiana

Peter Allain, P.E., PTOE

### Maine

Bruce A. Ibarguen, P.E.

### Maryland

Thomas Hicks, P.E.

### Massachusetts

Neil E. Boudreau

### Michigan

Mark W. Bott,

### Minnesota

Bernard J. Arseneau  
 Susan M. Groth

### Mississippi

Robert "Wes" Dea

### Missouri

Eileen Pachters

### Montana

Thomas Williams, P.E.

### Nebraska

Daniel J. Waddle, P.E.

### Nevada

Fred Droes

### New Hampshire

William Lambert

### New Jersey

Douglas R. Bartlett

### New Mexico

Vacant,

### New York

David J. Clements, P.E.

### North Carolina

J. Kevin Lacy, P.E., CPM

### North Dakota

Al Covlin

### Ohio

Dave Holstein, P.E.

### Oklahoma

Harold Smart

### Oregon

Edward L. Fischer, P.E.  
 PTOE

### Pennsylvania

Glenn C. Reese, P.E. PTOE

### Puerto Rico

Felipe Luyanda-Andino

### Rhode Island

Robert Rocchio, P.E.

### South Carolina

Richard B. Werts, P.E.

### South Dakota

John Adler, P.E.

### Tennessee

Don L. Dahlinger  
 Michael L. Tugwell

### Texas

Margaret (Meg) A. Moore,  
 P.E.

### Utah

Robert E. Hull, P.E.

### Vermont

Bruce Nyquist, P.E.

### Virginia

Raymond J. Khoury, P.E.

### Washington

Theodore Trepanier, P.E.

### West Virginia

Cindy Cramer, P.E.

### Wisconsin

Thomas N. N. Johnson, P.E.,  
 PTOE

### Wyoming

Michael N. Kostovich

### U.S. DOT Member

### FHWA

Hari Kalla

### AASHTO

### AASHTO

Mark S. Bush, P.E., PTOE

### Associate Member—Bridge, Port, and Toll

### Golden Gate Bridge

Maurice Palumbo, P.E.

### N.J. Turnpike Authority

Sean M. Hill

### Associate Member— Cities, Counties, and State Governments

### City of Minneapolis

Jon Wertjes

### Associate Member— International

### Manitoba

Glenn A. Cuthbertson, P.E.

### Nova Scotia

Bernie Clancey, P.E.

### Saskatchewan

Sukhy Kent

Currently in preview, click buy full version

# Table of Contents

<b>Chapter 1</b>	<b>Introduction</b> .....	1-1
1.1	Introduction .....	1-1
1.2	Principles, Themes, and Emerging Issues for Guidelines .....	1-2
1.3	Summary of Traffic Data Programs .....	1-3
1.4	Structure of the Document .....	1-8
<b>Chapter 2</b>	<b>Traffic Data Collection Needs</b> .....	2-1
2.1	Introduction .....	2-1
2.2	Traffic Count Types and Needs .....	2-2
2.3	Estimating Traffic Data Collection Needs .....	2-11
2.4	Reducing Traffic Data Collection Needs .....	2-24
2.5	Estimating Staff and Resource Requirements for Traffic Data Collection .....	2-24
2.6	Conclusion .....	2-32
2.7	References .....	2-33
<b>Chapter 3</b>	<b>Traffic Monitoring Equipment</b> .....	3-1
3.1	Introduction to Data Collection Equipment .....	3-1
3.2	Equipment Technologies .....	3-3
3.3	Data Collection Equipment .....	3-23
3.4	Equipment Selection .....	3-45
3.5	Equipment Installation and Maintenance .....	3-49
3.6	Traffic Counting on Congested Roadways .....	3-59
3.7	The Data Implications of the Growing Emphasis on Roadway Operations .....	3-61
3.8	Conclusion .....	3-62
3.9	References .....	3-62
<b>Chapter 4</b>	<b>Quality Assurance for Traffic Data</b> .....	4-1
4.1	Introduction .....	4-1
4.2	Integrating Quality Assurance into Traffic Monitoring Programs .....	4-3
4.3	What Is Data Quality? .....	4-10
4.4	Assessing Data Quality .....	4-12

TABLE OF CONTENTS

4.5 Validation Criteria for Vehicle Count, Classification, and Weight Data ..... 4-17

4.6 Severity Levels for Validation Criteria..... 4-20

4.7 Other Quality Control Considerations..... 4-22

4.8 Dealing with Missing Data ..... 4-26

4.9 Quality-Level Designations ..... 4-31

4.10 Example of Quality Assessment for WIM Data ..... 4-32

4.11 References and Resources ..... 4-37

**Chapter 5 Summarizing Traffic Data..... 5-1**

5.1 Summarizing Data from Continuous Counters..... 1

5.2 Adjustment Factors ..... 5-8

5.3 Summarizing Short-Term Counts..... 5-22

5.4 Estimating Precision of Traffic Statistics ..... 5-27

5.5 Estimating Section-Specific HPMS Traffic Statistics ..... 5-30

5.6 System-Level Summary Data..... 5-33

5.7 Traffic Statistics for the Mechanistic-Empirical Pavement  
Design Guide (MEPDG)..... 5-34

5.8 References ..... 5-35

**Chapter 6 Reporting and Managing Traffic Data ..... 6-1**

6.1 Introduction ..... 6-1

6.2 Basis ..... 6-2

6.3 Database Considerations..... 6-3

6.4 Disseminating Traffic Information ..... 6-7

6.5 Database Procedures ..... 6-7

6.6 Traffic Data Reports ..... 6-13

6.7 Data Retention ..... 6-27

6.8 References ..... 6-35

**Chapter 7 Integrating Operations Data..... 7-1**

7.1 Introduction ..... 7-1

7.2 Current Practice ..... 7-3

7.3 Steps for Success..... 7-6

7.4 Chapter Summary ..... 7-20

7.5 References ..... 7-21

**Appendix A ..... A-1**  
Examples of Data Validation Standards..... A-1

**Appendix B ..... B-1**  
Case Studies of the Integration of Archived Operations Data ..... B-1

**Appendix C** .....C-1  
 Literature Review ..... C-1

**Appendix D** .....D-1  
 Abbreviations..... D-1  
 Definitions ..... D-3

**LIST OF TABLES**

1-1 Comparison of TMG to Guidelines .....1-7  
 2-1 Examples of Highway Traffic Data Uses.....2-4  
 2-2 Examples of Customer Needs for Traffic Data .....2-5  
 2-3 Sample Performance Measures by Type .....2-10  
 3-1 Vehicle Classification Technologies .....3-34  
 3-2 Comparison of WIM Technologies.....3-42  
 4-1 Excerpt from a VDOT Contracting Agreement for Traffic Data Collection  
 and Equipment Maintenance .....4-7  
 4-2 Definitions for Traffic Data Quality Measures .....4-11  
 4-3 Recommended Minimum Validation Criteria for Traffic Data.....4-18  
 4-4 VDOT Traffic Data Quality-Level Designations.....4-32  
 4-5 Gross Vehicle Weights.....4-35  
 5-1 Load Ranges Used for Load Spectra .....5-6  
 5-2 Development of Axle-Correction Ratios .....5-14  
 5-3 Development of Growth Factors .....5-17  
 5-4 Development of Time-of-Day Traffic Ratio.....5-21  
 6-1 Categories of Traffic Information.....6-14  
 6-2 Users’ Traffic Data Needs .....6-15  
 6-3 Standard/Nonstandard AVMT Report.....6-19  
 6-4 Rounding Convention .....6-25  
 6-5 Traffic Data Retention Periods.....6-29  
 6-6 Hourly Percent of Daily Traffic by Month—MAWDT .....6-33  
 6-7 Hourly Percent of Daily Traffic by Month—MAWET .....6-34  
 7-1 Questions to Better Understand Archived Operations Data.....7-8  
 7-2 Recommended Additional Validation Criteria for Archived Data .....7-11  
 7-3 Hourly Traffic Volume Format (#3 Record) from Traffic Monitoring Guide.....7-17  
 A-1 Basic Validation Criteria for Traffic Counts from a State DOT ..... A-1  
 A-2 Validation Criteria from Commercial Traffic Data Software..... A-2  
 A-3 Validation Criteria from the Traffic Data Edit Procedures Pooled-Fund Study... A-5

**LIST OF FIGURES**

1-1 Summary of Traffic Data Programs .....1-3  
 2-1 Example of Count Nesting .....2-14  
 3-1 Illustrations of FHWA’s 13-Category Vehicle Classification System.....3-15

TABLE OF CONTENTS

3-2 Picture of a Trailer-Mounted, Non-Intrusive Traffic Volume Counter . . . . . 3-29

3-3 Example of a Pole-Mounted, Non-Intrusive Traffic Volume Counter . . . . . 3-30

3-4 Common Sensor Layout for a Permanent Axle-Based Vehicle Classifier . . . . . 3-39

3-5 Sketch of 3M Microloop Installation . . . . . 3-57

4-1 Missing Data Patterns in Archived Operations Data from Austin, Texas  
Percent Complete for Hourly Volume Data . . . . . 4-29

4-2 WIM Quality Assessment Example 1 . . . . . 4-33

4-3 WIM Quality Assessment Example 2 . . . . . 4-34

4-4 WIM Quality Assessment Example 3 . . . . . 4-34

4-5 WIM Quality Assessment Example 4 . . . . . 4-35

4-6 WIM Quality Assessment Example 5 . . . . . 4-36

4-7 WIM Quality Assessment Example 6 . . . . . 4-37

6-1 Hourly Traffic by Direction . . . . . 6-12

6-2 Diurnal Distribution . . . . . 6-21

6-3 Monthly Traffic Ratios . . . . . 6-21

6-4 Day of the Week Traffic Ratios . . . . . 6-22

6-5 Day of the Week Traffic Ratios . . . . . 6-22

6-6 Day of the Week Traffic Ratios . . . . . 6-23

6-7 Snoqualmie Pass Traffic, 1989 . . . . . 6-23

7-1 Example of Traffic Flow and Speed Profile Used to Assess Data Quality  
in Phoenix, Arizona . . . . . 7-12

7-2 Missing Data Patterns in Archived Operations Data from Austin, Texas . . . . . 7-13

7-3 Priority Traffic Detectors Designated in Phoenix, Arizona . . . . . 7-14

## CHAPTER 1

# Introduction



## 1.1 Introduction

### 1.1.1 Objective

The objective of the guidelines is to improve the quality of the traffic information that supports decisions at all levels of the transportation profession. Traffic data programs are essential for state Departments of Transportation to accomplish their mission of ensuring safety and mobility to the traveling public. Traffic data supports capital investment programs and budgets, as well as effective design and maintenance programs.

This document is a reference for professional traffic monitoring and establishes recommended national traffic monitoring practices that reflect current practice and advances made in the past several years.

### 1.1.2 Background

The first edition of the American Association of State Highway and Transportation Officials (AASHTO) *Guidelines for Traffic Data Programs* was developed by an AASHTO Task Force that was formed in 1990 and was composed of members of two AASHTO Committees and representatives of the Federal Highway Administration (FHWA) and the Strategic Highway Research Program. That edition built upon and supplemented the 1985 edition of FHWA's *Traffic Monitoring Guide* (TMG).

Since publication of the first edition of the guidelines in 1992, many advances have been made in traffic monitoring procedures, and updated editions of the TMG were published in 1994 and 2001. This new edition of the Guidelines represents a general updating of all material so the content reflects the current state of the art and complements the TMG.

The guidebook is intended for use by state and local transportation agencies, as well as others involved in traffic data programs.